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REMEDIATION SYSTEM EVALUATION

McCORMICK AND BAXTER
SUPERFUND SITE
PORTLAND, OREGON



Report of the Remediation System Evaluation,
Site Visit Conducted at the
McCormick and Baxter Superfund Site
August 23-24, 2001

Final Report
February 8, 2002



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EXECUTIVE SUMMARY

The McCormick and Baxter Creosoting Company, Portland Plant, Superfund Site is located adjacent to the Willamette River in Portland, Oregon and addresses contamination of soil, groundwater, and river sediments stemming from creosoting operations between 1944 and October 1991. The site lies between a bluff and the river and consists of 43 acres of land and over 15 acres of river sediments. The site is bordered by industrial properties along the river and by a residential areas on the bluff. A Burlington Northern Railroad spur crosses the western portion of the property, and a Union Pacific Railroad crosses the northeastern portion of the site below the bluff. The site consists of three operable units for addressing contamination: one each for soil, groundwater, and river sediments.

Current subsurface contamination at the site exists predominantly as NAPL that is migrating in subsurface "stringers" toward the river. Observations by the site team indicate that NAPL occasionally discharges directly into the river from seeps located on the shore. Dissolved groundwater concentrations for all constituents are below the alternate cleanup levels for groundwater; thus, emphasis is placed on removing and retarding migrating NAPL.

A Remediation System Evaluation (RSE) was conducted on the system in August 2001. A RSE involves a team of expert hydrogeologists and engineers, independent of the site, conducting a third-party review of site operations. The evaluation includes reviewing site documents, visiting the site for up to 1.5 days, and compiling a report that includes recommendations to improve the system.

The RSE was intended to evaluate the pump-and-treat and NAPL collection systems associated with the groundwater operable unit; however, these interim remedies have been discontinued and emphasis is now placed on alternate strategies for containment of groundwater and NAPL contamination. This RSE report, therefore, summarizes the groundwater remedies to date but offers recommendations to improve effectiveness, reduce life-cycle costs, and gain site close-out that are in line with the selected alternate strategies. Many of these recommendations occurred during discussions with site managers at the site visit and in subsequent conference calls and took the form of both constructive criticism of proposed strategies, contribution of additional strategies, and approaches to implementing the selected remedial actions.

The primary remedial strategies discussed by the site managers and the RSE team included a vertical barrier wall, a permeable sediment cap, a targeted sediment cap with selected materials designated for NAPL seep areas, and cutoff trenches. In addition to discussing these strategies the RSE also made the following recommendations:

- The selected strategies should be implemented in a phased approach with defined schedules and budgets. The construction and implementation of one strategy may provide additional information pertinent to the design and implementation of the other strategies or may alter site conditions.
- Detailed cost-benefit analyses should be conducted to best determine the most appropriate variations on the proposed strategies, especially with respect to the sediment cap. These cost-benefit analyses among the various sediment cap options should be based on life-cycle costs and should incorporate for each option the initial cost, estimated frequency for replacing cap materials in NAPL seep areas, and cost of replacing those materials.

- The site managers should proceed with implementation in an experimental approach. Monitoring and evaluation of the site conditions after implementation will provide detailed information regarding the remedy's performance. In the case of the sediment cap, this information may reveal specific NAPL seep areas and estimates of the time required for the NAPL to breakthrough the cap. In case the cap is compromised by seeping NAPL, this information could be useful in determining the areas of the cap to be replaced and, through further cost-benefit analyses, the type of material to be used in those compromised areas.

PREFACE

This report was prepared as part of a project conducted by the United States Environmental Protection Agency (USEPA) Technology Innovation Office (TIO) and Office of Emergency and Remedial Response (OERR). The objective of this project is to conduct Remediation System Evaluations (RSEs) of pump-and-treat systems at Superfund sites that are "Fund-lead" (i.e., financed by USEPA). RSEs are to be conducted for up to two systems in each EPA Region with the exception of Regions 4 and 5, which already had similar evaluations in a pilot project.

The following organizations are implementing this project.

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|--|-------------|--|
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The project team is grateful for the help provided by the following EPA Project Liaisons.

| | | | |
|-----------------|-----------------------------|------------------|--------------------------------|
| Region 1 | Darryl Luce and Larry Brill | Region 6 | Vincent Malott |
| Region 2 | Diana Cutt | Region 7 | Mary Peterson |
| Region 3 | Kathy Davies | Region 8 | Armando Saenz and Richard Muza |
| Region 4 | Kay Wischkaemper | Region 9 | Herb Levine |
| Region 5 | Dion Novak | Region 10 | Bernie Zavala |

They were vital in selecting the Fund-lead P&T systems to be evaluated and facilitating communication between the project team and the Remedial Project Managers (RPM's).

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1.0 INTRODUCTION

1.1 PURPOSE

In the *OSWER Directive No. 9200.0-33, Transmittal of Final FY00 - FY01 Superfund Reforms Strategy*, dated July 7, 2000, the Office of Solid Waste and Emergency Response outlined a commitment to optimize Fund-lead pump-and-treat systems. To fulfill this commitment, the US Environmental Protection Agency (USEPA) Technology Innovation Office (TIO) and Office of Emergency and Remedial Response (OERR), through a nationwide project, is assisting the ten EPA Regions in evaluating their Fund-lead operating pump-and-treat systems. This nationwide project is a continuation of a demonstration project in which the Fund-lead pump-and-treat systems in Regions 4 and 5 were screened and two sites from each of the two Regions were evaluated. It is also part of a larger effort by TIO to provide USEPA Regions with various means for optimization, including screening tools for identifying sites likely to benefit from optimization and computer modeling optimization tools for pump and treat systems.

This nationwide project identifies all Fund-lead pump-and-treat systems in EPA Regions 1 through 3 and 6 through 10, collects and reports baseline cost and performance data, and evaluates up to two sites per Region. The site evaluations are conducted by EPA-TIO contractors, GeoTrans, Inc. and the United States Army Corps of Engineers (USACE), using a process called a Remediation System Evaluation (RSE), which was developed by USACE. The RSE process is meant to evaluate performance and effectiveness (as required under the NCP, i.e., and "five-year" review), identify cost savings through changes in operation and technology, assure clear and realistic remediation goals and an exit strategy, and verify adequate maintenance of Government owned equipment.

The McCormick and Baxter Superfund Site was chosen to receive an RSE based on an initial screening of the pump-and-treat systems managed by USEPA Region 10 as well as discussions with the Superfund Reform Initiative Project Liaison for that Region. This site has high operation costs relative to the cost of an RSE and a long projected operating life. This report provides a brief background on the site and current operations, a summary of the observations made during a site visit, and recommendations for changes and additional studies. The cost impacts of the recommendations are also discussed.

A report on the overall results from the RSEs conducted for this system and other Fund-lead P&T systems throughout the nation will also be prepared and will identify lessons learned and typical costs savings.

1.2 TEAM COMPOSITION

The team conducting the RSE consisted of the following individuals:

Frank Bales, Chemical Engineer, USACE, Kansas City District
Rob Greenwald, Hydrogeologist, GeoTrans, Inc.
Peter Rich, Civil and Environmental Engineer, GeoTrans, Inc.
Doug Sutton, Water Resources Engineer, GeoTrans, Inc.

1.3 DOCUMENTS REVIEWED

| Author | Date | Title |
|----------------------------|-----------|---|
| PTI Environmental Services | 9/1992 | Remedial Investigation Report, McCormick and Baxter Creosoting Company |
| US EPA | 3/1/1996 | Record of Decision, McCormick and Baxter Creosoting Company, Portland Plant, Portland, Oregon |
| Ecology and Environment | 10/1997 | Draft Remedial Action Conceptual Site Model and Data Gap Evaluation Report, McCormick and Baxter Creosoting Company, Portland Plant |
| US EPA | 3/1/1998 | Amended Record of Decision, McCormick and Baxter Creosoting Company, Portland Plant, Portland, Oregon |
| ODEQ | 4/30/1998 | Quarterly Progress Report for the McCormick and Baxter Creosoting NPL site, January 1 through March 31, 1998 |
| Ecology and Environment | 3/1999 | Remedial Action Groundwater Data Summary Report, McCormick and Baxter Creosoting Company, Portland Plant, Portland, Oregon |
| Ecology and Environment | 3/1999 | Remedial Actions Semiannual Report, July 1, 1998 through December 31, 1998, McCormick and Baxter Creosoting Company, Portland, Oregon |
| ODEQ | 5/19/1999 | Quarterly Progress Report for the McCormick and Baxter Creosoting NPL site, January 1 through March 31, 1999 |
| Ecology and Environment | 11/1999 | Remedial Actions Semiannual Report, January 1, 1999 through June 30, 1999, McCormick and Baxter Creosoting Company, Portland, Oregon |
| Ecology and Environment | 4/2000 | Remedial Actions Semiannual Report, July 1, 1999 through December 31, 1999, McCormick and Baxter Creosoting Company, Portland, Oregon |

| Author | Date | Title |
|-------------------------|-----------|---|
| ODEQ | 4/27/2000 | Quarterly Progress Report for the McCormick and Baxter Creosoting NPL site, January 1 through March 31, 2000 |
| Ecology and Environment | 8/2000 | Remedial Actions Semiannual Report, January 1, 2000 through June 30, 2000, McCormick and Baxter Creosoting Company, Portland, Oregon |
| ODEQ | 9/2000 | Remedial Action Report for the McCormick and Baxter Creosoting Company Site, Portland Plant, Interim Groundwater Treatment System Operable Unit (OU1) |
| Ecology and Environment | 3/2001 | Remedial Actions Semiannual Report, July 1, 2000 through December 31, 2000, McCormick and Baxter Creosoting Company, Portland, Oregon |
| ODEQ | 5/21/2001 | Quarterly Progress Report for the McCormick and Baxter Creosoting NPL site, January 1 through March 31, 2001 |
| Ecology and Environment | 8/2001 | Remedial Actions Semiannual Report, January 1, 2001 through June 30, 2001, McCormick and Baxter Creosoting Company, Portland, Oregon |
| ODEQ | 9/2001 | Draft First Five-Year Review Report for McCormick and Baxter Creosoting Company Superfund Site, Portland, Multnomah County, Oregon |

1.4 PERSONS CONTACTED

The following individuals were present for the RSE site visit:

Al Goodman, RPM, USEPA Region X
 John Montgomery, Project Manager, Ecology and Environment
 Kevin Parrett, Site Manager, Oregon Department of Environmental Quality
 Bernard Zavala, Hydrologist, USEPA Region X

In addition, the following individuals provided information to the RSE team during conference calls subsequent to the RSE site visit:

Susan Gardner, Sediment Engineer, Ecology and Environment
 Mark Ochsner, Project Hydrogeologist, Ecology and Environment
 Michael Easterly, Engineer, USACE, Seattle District

1.5 SITE LOCATION, HISTORY, AND CHARACTERISTICS

1.5.1 LOCATION AND HISTORY

The McCormick and Baxter Creosoting Company, Portland Plant, Superfund Site is located on the Willamette River in Portland, Oregon and addresses contamination of soil, groundwater, and river sediments from creosoting operations between 1944 and October 1991. The site lies between a bluff and the river and consists of 43 acres of land and over 15 acres of river sediments. The site is bordered by industrial properties along the river and by a residential areas on the bluff. A Burlington North Railroad spur crosses the western portion of the property, and a Union Pacific Railroad crosses the northeastern portion of the site below the bluff. Figure 1-1 provides a map of the area.

The site consists of three operable units for addressing contamination: one each for soil, groundwater, and river sediment. This RSE was intended to evaluate the pump-and-treat systems associated with the groundwater operable unit; however, these aspects of the remedy have been replaced by manual skimming of NAPL and emphasis is now placed on other components of the remedy outlined in the ROD, such as a vertical barrier wall and a sediment cap. This RSE report, therefore, summarizes the groundwater remedies to date but offers recommendations in line with the selected remedial actions.

1.5.2 POTENTIAL SOURCES

Operations at the McCormick and Baxter facility included use of creosote and pentachlorophenol (PCP) in oil, as well as compounds containing chromium, arsenic, copper, and zinc. Three main source areas exist: the tank farm area (TFA), central process area (CPA), and former waste disposal area (FWDA). Process wastes were discharged to the TFA until 1971 and to the FWDA between 1968 and 1971. In addition to these three primary source areas, a number of other smaller former disposal areas were located throughout the site, and between 1950 and 1965 wastes including creosote and PCP were applied on site for dust suppression. Four outfalls were in use during facility operations. One was used for wastewater, and three were used for stormwater. A number of spills may have also occurred throughout the history of the facility along the docks serving as potential sources to the existing river sediment contamination. The locations of the primary source areas and other pertinent site features are depicted in Figure 1-2.

Onsite soil within four feet of the surface with contamination above action levels were removed and remaining site features were demolished in the first phase of the soil operable unit. The draft Remedial Design Data Summary Report, E&E, November 1997, indicates that soils below the four-foot removal level still have concentrations above the contamination action level. A soil cap will be installed upon implementation of the groundwater remedy. An enhanced NAPL recovery system specified in the ROD was constructed through upgrades and enhancements to an interim groundwater treatment system initiated in 1994 and operating at the time of the ROD. The enhanced system consisted of total fluids extraction in the TFA at a rate of up to 10 gpm and pure-phase NAPL extraction in the TFA and FWDA at varying rates (from January through June 1999, approximately 100 gallons of NAPL were recovered). In September 2000, total fluids extraction and treatment and automated NAPL recovery were discontinued due to relatively high cost of operation for the relatively small amount of NAPL recovered. Manual NAPL recovery with skimmers continued, however, because manual recovery provided similar effectiveness for a lower cost.

1.5.3 HYDROGEOLOGIC SETTING

The site is located on an area that was constructed by placement of borrowed material, perhaps including dredged material, along mile 7 of the Willamette River during the early 1900s. The site is generally flat and lies between a 120-foot high bluff along the northeastern border and the Willamette River to the southwest. A sandy beach along the river is exposed during the majority of the year but is submerged during high river stages that typically occur in the late winter and early spring.

Surface elevations on site range from 29 to 36 feet above mean sea level (MSL) with the land surface sloped toward the river. The site also includes 15 acres of river sediments. Fill that is composed of fine to medium grained sands, with areas near the TFA also consisting of sawdust and wood chips, extends for 20 to 30 feet below ground surface. Alluvial sand and silt deposits exist beneath this fill and have a thickness of nearly 100 feet near the bluff to the northeast and 0 feet in places near the river to the southwest. Beneath the silt layer is an intermediate aquifer that varies in thickness. In the central process area it is 12 feet thick and in the TFA, where the overlying silt layer is over 100 feet thick, it is nonexistent. Near the river, this intermediate zone is connected with the deeper zone which is primarily alluvial sands consisting of fine to medium grained alluvial sand. This intermediate aquifer is approximately 50 feet thick and is hydraulically connected to the deeper aquifer near the river.

Groundwater in the area is generally 20 to 25 feet below ground surface and flows toward the river during much of the year. Reversal of flow from the river toward the site occurs near the river during high water periods in the late winter and spring when the river stage is higher than the groundwater elevation.

1.5.4 DESCRIPTION OF GROUND WATER PLUME

Current subsurface contamination at the site exists predominantly as NAPL that is migrating in subsurface "stringers" toward the river and is occasionally discharging into the river through seeps in the Willamette Cove area and along the riverfront upstream from the railroad bridge. Dissolved groundwater concentrations for all constituents are below the alternate cleanup levels for groundwater; thus, emphasis is placed on removing and retarding migrating NAPL. The primary visible seep is located along the beach in Willamette Cove. Additional smaller seeps are reported along the beach on the riverfront. Seeps are predominantly at water surface, but it is suspected that seeps may continue beneath the water surface.

2.0 SYSTEM DESCRIPTION

2.1 SYSTEM OVERVIEW

The interim remedy for the groundwater operable unit has consisted of 2 automated NAPL recovery systems operating from 1996 to October 2000. These systems were located in the Former Waste Disposal Area (FWDA) in the southwest corner of the site and the Tank Farm Area (TFA) about 1,000 feet to the east of the FWDA in the center of the site. Until 1998, the TFA system was operated as a total fluids extraction system with 3 extraction wells and included a dissolved air flotation unit (DAF) for treatment. The system was operated as a pilot system 40 hours/week during this time. As this system required extensive operating oversight without commensurate recovery advantages, it was replaced with a system similar to that at the FWDA. These systems allowed full time automated NAPL recovery with minimal coproduced groundwater to treat and discharge. Both the TFA and FWDA systems then continued operation until September 2000 when total fluids extraction and treatment and automated NAPL recovery were discontinued due to relatively high cost of operation for the relatively small amount of NAPL recovered.

2.2 EXTRACTION SYSTEM

During the last full semiannual period (first half of 2000) in which the continuous systems were run, the FWDA NAPL extraction system included 6 extraction wells and the TFA NAPL extraction system included 9 extraction wells. Pneumatic submersible pumps were used in each of the continuous system extraction wells. The total fluid flow rates during this period were about 2.6 gpm for the TFA and 0.5 gpm for the FWDA. NAPL removed during this period amounted to 136.56 gallons. During the first half of 2001, with the continuous systems shut down and only passive collection and manual extraction, NAPL recovery has been reduced to 10.38 gallons. This reduction in recovered NAPL could also be partially due to drought conditions during 2001. The total amount of NAPL extracted since recorded collection began in December 1995 is about 2000 gallons. On average, through 2001 NAPL recovery costs have been approximately \$800 per gallon of recovered NAPL.

2.3 TREATMENT SYSTEM

Both the TFA and FWDA systems consisted of phase separation, particulate filtration, anthracite/clay filtration, granular activated carbon adsorption and metals adsorbent resin (Aqua-Fix from ATA Technologies). System component sizes, interconnections and controls were not examined for this effort as operation of the systems has been suspended. During their operation weekly effluent samples were taken from the treatment system. During the first half of 2000, each system's effluent exceeded the copper discharge standard one time and was below the allowable pH range numerous times.

3.0 SYSTEM OBJECTIVES, PERFORMANCE AND CLOSURE CRITERIA

3.1 CURRENT SYSTEM OBJECTIVES AND CLOSURE CRITERIA

The remedial action objectives as presented in the 1996 Record of Decision for each of the operable units are summarized in the following list:

Soil Operable Unit

- Prevent human exposure through direct contact or incidental ingestion to contaminated surface and near-surface soil that would result in an excess lifetime cancer risk above 1×10^{-6} for individual compounds; above 1×10^{-5} for additive carcinogenic compounds; or above a Hazard Index of 1 for noncarcinogenic compounds in an industrial land use scenario.
- Prevent storm water run-off containing contaminated soil from reaching the Willamette River.

Groundwater Operable Unit

- Prevent human exposure to or ingestion of groundwater with contaminant concentrations in excess of federal and state drinking water standards or protective levels.
- Minimize further vertical migration of NAPL to the deep aquifer
- Prevent groundwater discharges to the Willamette River that contain dissolved contaminants that would result in contaminant concentrations within the river in excess of background concentrations or in excess of water quality criteria for aquatic organisms.
- Minimize NAPL discharges to the Willamette River beach and adjacent sediment to protect human health and the environment.
- Remove mobile NAPL to the extent practicable to reduce the continuing source of groundwater contamination and potential for discharge to the Willamette River sediment.

Sediment Operable Unit

- Prevent humans and aquatic organisms from direct contact with contaminated sediment.
- Minimize releases of contaminants from sediment that might result in contamination of the Willamette River in excess of federal and state ambient water quality criteria.

3.2 OPERABLE UNIT CLEANUP GOALS

The cleanup levels as presented in the September 2001 5-year review for each of the operable units are summarized below:

Soil Operable Unit

| Contaminant | Cleanup Goal (mg/kg) |
|-------------------|----------------------|
| arsenic | 8 |
| PCP | 50 |
| carcinogenic PAHs | 1 |
| dioxin/furans | 4×10^{-5} |

Groundwater Operable Unit

Because of the extensive NAPL contamination, it is not technically practicable to restore the groundwater under the site to drinking water quality; therefore, site-specific alternate concentration limits (ACLs) for the contaminants that are consistent with CERCLA Section 121(d)(2)(B)(ii) and are protective of the environment were developed.

| Contaminant | Cleanup Goal (mg/L) |
|-------------------------------------|---------------------|
| total PAHs | 43 |
| PCP | 5 |
| dioxin/furans | 2×10^{-7} |
| arsenic, chromium, copper, and zinc | 1 (each) |

Sediment Operable Unit

| Contaminant | Cleanup Goal (mg/kg) |
|-------------------|----------------------|
| arsenic | 12 |
| PCP | 100 |
| carcinogenic PAHs | 2 |
| dioxins/furans | 0.008 |

4.0 FINDINGS AND OBSERVATIONS FROM THE RSE SITE VISIT

4.1 FINDINGS

The RSE team found that operation of the two automated NAPL extraction systems and the total fluids extraction system had been suspended for valid reasons. The EPA, Oregon DEQ and contractor Ecology & Environment considered the effectiveness of the systems in meeting the ROD goals versus the cost to continue to operate the system. They determined that the systems provided minimal benefit above skimming and manual removal but cost twice as much. The group is currently considering a barrier wall, sediment cap, and cutoff trenches to intercept NAPL seeps.

4.2 SUBSURFACE PERFORMANCE AND RESPONSE

4.2.1 WATER LEVELS

Monitoring wells that contain LNAPL and DNAPL are gaged on a weekly basis for NAPL. Wells which have not historically contained NAPL are gaged monthly. The gaging events include over 50 wells. Water level measurements indicate that shallow groundwater generally moves from the site towards the river, but gradient reversals occur near the river with rising river levels. Daily groundwater fluctuations of several feet are common in wells due to river elevation changes and precipitation.

Hydraulic containment of groundwater beyond several feet from an extraction well was not part of the automated system goal, and the minimal volume extracted by the systems did not influence overall site groundwater flow or NAPL seepage. NAPL seeps from the subsurface to the Willamette River have been observed sporadically at the site. No seepage had been noted by site managers for a few years, but a seep of over 100 feet in length along the beach in the Willamette Cove area was noted in May 2001 and has continued throughout the summer.

NAPL thicknesses and the number of wells containing NAPL have decreased substantially since removal efforts began. In June 2001, LNAPL was present in 15 of the 40 wells gaged with an average thickness in the 15 wells of approximately 0.4 feet. The highest measured thickness was 1.54 feet, which was measured in a well in the FWDA. The other two highest measured thicknesses were 0.98 and 1.47 feet, both of which were measured in wells in the TFA.

4.2.2 CONTAMINANT LEVELS

Groundwater samples are collected semiannually from about 12 monitoring wells in the shallow, intermediate and deep groundwater zones. Samples are analyzed for metals and SVOCs including PCP, with select analysis for dioxin/furan compounds. During the last 2 sampling events, ACLs were exceeded once for zinc in one well and once for total PAHs in another well. ACLs for this site are at relatively high levels due to site specific characteristics. The ACL for total PAHs of 43 mg/l is not likely to be exceeded unless NAPL is directly impacting the sample.

NAPL contamination exists throughout the site but primarily in the TFA and FWDA. Migration of NAPL offsite is also evident in active seeps, especially into Willamette Cove, and in sediment cores from

the remedial investigation in 1992. Quantitative analyses of sediment cores revealed concentrations as high as 8,200 mg/kg for low molecular weight PAHs and 2,000 mg/kg for high molecular weight PAHs approximately 200 feet from the shore and at a depth of approximately 9 feet (core K6c). Qualitative analyses reported evidence of creosote contamination (either sheen or odor) at depths exceeding 40 feet below the river bed (cores K5C, L1C, and L5C).

4.3 COMPONENTS OR PROCESSES THAT ACCOUNT FOR MAJORITY OF MONTHLY COSTS

Currently about \$5,000 per month is spent on NAPL gaging and collection activities. This is the majority of the approximately \$100,000 per year being spent on site O&M activities. The balance is spent on semiannual reporting and project management. During the operation of the automated systems more than \$200,000 additionally was required for O&M. This sum was necessary even after the dissolved air flotation (DAF) treatment was abandoned to reduce operating costs.

The site has a budget of \$1.3 million for design from July 2001 through the end of the design, including project administration, community involvement, and cultural resources. These costs should take the project through the final design, including procurement, contract language, and a package for bidding. A health and safety plan would then be made site specific for additional cost. Including the pre-July 2001 design costs, the total cost of design is approximately \$2 million. The total estimated cost for the barrier wall is \$2.5 million and for the sediment cap is \$4.2 million (including bulkhead removal, mobilization and demobilization, monitoring well abandonment, removal of pilings, a sand cap, armoring, regrading the steep parts of the shoreline, administration, oversight, construction documents, and a 45% contingency.

Thus, the estimated design costs by the end of 2001 will be approximately 30% of the cost. At the time of the RSE in late August 2001, however, the material for the sediment cap and wall as well as many other design details had not yet been determined suggesting the likelihood that additional design costs will be incurred in 2002 potentially increasing design costs well beyond the current 30%.

4.4 RECURRING PROBLEMS OR ISSUES

NAPL discharge to the river sediment has not been controlled by the remediation efforts based on visual observation and sediment sampling data.

4.5 SAFETY RECORD

A fire unrelated to site activities occurred in 2001 along the railroad line along the bluff to the northeast of the site. No injuries associated with this fire or site activities have been reported.

5.0 EFFECTIVENESS OF THE SYSTEM TO PROTECT HUMAN HEALTH AND THE ENVIRONMENT

5.1 GROUND WATER

Groundwater at the site is impacted by site-related contamination but is not used for drinking water. Contaminated groundwater is generally below the site-specific ACLs. The following table presents the results from water quality monitoring in wells along the riverfront or Willamette Cove.

| | Arsenic (ug/L) | Copper (ug/L) | Chromium (ug/L) | Zinc (ug/L) | PCP (ug/L) | PAHs (ug/L) | CPAHs (ug/L) | TCDD (ug/L) |
|--------|-------------------|------------------|--------------------|----------------|---------------|----------------|-----------------|--------------------|
| ACL | 1,000 | 1,000 | 1,000 | 1,000 | 5,000 | 43,000 | - | 2x10 ⁻⁴ |
| EW-19s | 40 | 2U | 1U | 5U | 530J | 6,000J | 5J | 2x10 ⁻⁴ |
| MW-LRs | 14 | 9 | 1U | 5U | 100UJ | 5,600J | 0.3J | 5x10 ⁻⁵ |
| MW-3s | 3.5 | 2U | 1.7 | 5 | 1U | 0.1 | 0.2U | - |
| MW-4s | 9.5 | 2U | 1.7 | 5U | 1U | 24 | 0.2U | - |
| MW-8i | 180 | 2.06 | 1.2 | 5U | 2,500UJ | 108,000 | 46J | - |
| MW-13i | 26 | 2U | 1.3 | 5U | 1U | 0.5 | 0.2U | - |
| MW-25s | 20 | 2U | 2U | 5U | 7J | 2,200 | 1UJ | - |
| MW-35s | 1U | 1U | 1U | 5U | 1U | 0.2U | 0.2U | - |

U = compound was analyzed for, but not detected. The corresponding value is the reporting limit.

J = concentration value is estimated

TCDD = 2,3,7,8 tetrachlorodibenzo-p-dioxin toxic equivalency quotient by EPA method 1613

5.2 SURFACE WATER

The ODEQ site manager indicated that surface water sampling above the river sediments showed contaminant concentrations below the ambient water quality criteria. Sporadic seeps of NAPL along the beach, however, provide a continuing source of contamination to river sediments and surface water along the site. The seeps appear limited to the shoreline but may exist in areas that are submerged throughout the year.

5.3 AIR

Air is not directly impacted by site activities.

5.4 SOILS

Surface and subsurface contaminated soils to a depth of 4 feet have been removed through excavation activities and offsite disposal. The final phase of the soil operable unit (i.e., the soil cap), however, will not be installed until the groundwater remedy is implemented. Subsurface soil is still a source of dissolved contamination of groundwater. This contamination is evident at various locations along the beach within a few inches of the surface.

5.5 WETLANDS AND SEDIMENTS

Approximately 15 acres of river sediments are impacted by site-related contamination. Some of this contamination may result from historical spills during unloading operations at the former docks and other sediment contamination results from NAPL seeps.

6.0 RECOMMENDATIONS

The RSE team found the site management dedicated to success of the remedial action and eager to receive technical assistance in considering the remedial strategy for the site. In consultation with the site contractor, the site management suspended operation of the automated NAPL collection systems as they were ineffective in achieving the Remedial Action Objectives and opted to continue with the less costly passive and manual NAPL collection. In considering the future course of the site and potential remedial strategies, the site management enlisted a permeability modeler from USACE and openly welcomed and encouraged the RSE team's contributions during and after the RSE site visit and subsequent conference calls.

6.1 CONTRIBUTION OF RSE TEAM TO DISCUSSIONS REGARDING REMEDIAL DESIGN

Because site activities no longer include an operating pump-and-treat system, the RSE team provides recommendations regarding alternate remedial strategies with focus on improving effectiveness, reducing life-cycle costs, and gaining site close-out. Many of these recommendations occurred during discussions with site managers at the site visit and in subsequent conference calls and took the form of both constructive criticism of proposed strategies and contribution of additional strategies.

Because groundwater sampled without the presence of NAPL meets ACLs, the primary concern for the site managers and the RSE team is to determine a cost effective strategy for preventing the migration of NAPL into the Willamette River and reducing exposure to contaminated sediments. Below are descriptions of the predominant strategies discussed by the site managers and the RSE team. These descriptions represent the collective thoughts of the site managers, engineers, and RSE team as discussed over the course of the RSE. They are not the sole ideas and/or recommendations of the RSE team.

Vertical Barrier Wall: A vertical barrier is being considered by the site managers to prevent migration of LNAPL and to some extent DNAPL, from the source areas. Downgradient (partially encompassing) or totally enclosing configurations have been discussed for the application. The totally enclosing configuration could increase the cost by approximately \$500,000 but offers no tangible benefit over the downgradient location. A totally encompassing wall may even require more maintenance than a partially enclosing wall because water would potentially have to be extracted and treated from the totally encompassing wall to offset natural recharge. A groundwater model for the site, however, suggests such extraction would not be necessary due to a lack of a competent aquitard in the FWDA. Wells or drains upgradient of the wall can be used to help collect product although barrier walls do not necessarily increase the ability for NAPL extraction.

Advantages: A properly constructed barrier wall may provide containment of LNAPL on the former McCormick and Baxter property at a low maintenance cost.

Disadvantages: A significant but unquantified percentage of mobile NAPL has already migrated past the wall location and could continue to discharge to the river for several years after wall installation. In some areas, including the FWDA and 100 feet between MW26s and MW-30s (according to Figure 4-25 in the 1992 Remedial Investigation Report), a barrier wall cannot be keyed into an underlying low permeability layer since none exists, and DNAPL migration in

these areas will not be controlled. With the wall in place, DNAPL migration to the river should be limited because the wall (which extends 48 feet below mean sea level) is designed to be deeper than the bottom of the navigation channel in the river (40 to 43 feet below mean sea level).

Cost estimates: As presented by the site managers and engineers, a downgradient (partially encompassing) slurry barrier wall over 2,000 feet in length and up to 80 feet deep is estimated to cost approximately \$2 million and a sheet pile barrier wall with a similar configuration is estimated to cost approximately \$3 million.

Permeable Sediment Capping: A permeable sediment cap with dredged material from the Columbia River has been considered by the site managers to cover contaminated river sediments and prevent exposure to contaminants.

Advantages: Dredged material from the Columbia River could be used as a permeable sediment cap that would cover contaminated sediment, effectively preventing exposure, at least temporarily, to sediments contaminated by previous spills of wood treating chemicals.

Disadvantages: Permeability modeling conducted by USACE indicates that in areas of NAPL seeps, breakthrough of NAPL through such a cap would likely occur in two months to two years. Thus, in areas where sediments are contaminated by seeps, regular dredging, offsite disposal, and replacement of cap material may be required. In addition, evidence suggests that both scour and sediment deposition occur in the areas where the cap would be placed. Thus, the potential exists for contaminated sediments to be re-exposed after cap placement.

Cost estimates: Based on a rough cost of \$30 per cubic yard and a 3-foot sediment cap that covers 15 acres, a permeable sediment cap will cost approximately \$2 million. The costs of regular maintenance would be dependent on the area of the cap that will be compromised by breakthrough of NAPL seepage, on rate with which this breakthrough occurs, and on the rate of scouring of cap material.

Targeted Sediment Cap: Also under consideration is a sediment cap made predominantly of permeable material but consisting of another material in targeted NAPL seepage areas. Three options were proposed for the seepage-area material: semi-impermeable dredged materials from the Willamette River, organophyllic material (adsorptive materials), and impermeable material. Each of these options is geared toward trading upfront costs in cap construction for a reduction in costs associated with regular maintenance or replacement of cap materials due to NAPL breakthrough in the seepage areas. Because an impermeable cap would require submerged drains to prevent migration around the impermeable material and such drains may be challenging to construct and maintain given the debris in the river during high water periods, the site managers are not considering an impermeable cap.

Advantages: A targeted cap could accomplish the exposure prevention goal, at least temporarily, and may reduce the frequency of replacing cap materials in NAPL seepage areas.

Disadvantages: Issues with construction are the primary concern because semi-impermeable material will likely include silts or fine sands that may be difficult to place on the river bed. In addition, if the semi-impermeable material is significantly less permeable than the surrounding material, then the NAPL may migrate around the semi-impermeable material as it would with an impermeable cap. Like the semi-impermeable material, the adsorptive materials could be

scoured if proper armoring is not included. The adsorptive materials are also significantly more expensive than semi-impermeable dredged material.

Cost estimates: The costs associated with this option have not been quantified.

Cutoff Trenches: Cutoff trenches installed along the shore are under consideration to prevent further migration of NAPL that would be beyond the reach of an installed barrier wall. NAPL in these trenches could either be collected with adsorptive material or possibly through manual collection through sumps.

Advantages: A distance of up to 50 feet would separate the proposed barrier wall and the riverfront. This option may help both with containment and collection of NAPL in that area at depths of up to 10 feet, thereby potentially reducing or eliminating NAPL seeps through the river sediments.

Disadvantages: Regular maintenance of such trenches would be required. These trenches or drains would be submerged during high water periods making maintenance difficult during those periods. The sump risers would have to be protected. The use of adsorptive material would increase the costs of the trenches both for the initial construction and for the periodic replacement of the adsorptive material.

Cost estimates: Installing trenches approximately 300 feet long and 20 feet deep with a perforated header and sumps could be installed with standard equipment and costs less than \$150,000. Shallower trenches would cost less. Maintenance costs will depend on the amount of NAPL that is collected and disposed of offsite.

Hydraulic Control: Control of LNAPL migration is possible if enough groundwater is withdrawn from the aquifer to form a capture zone at the TFA and FWDA. The volume pumped would be significantly greater than the discontinued system treated. Treating a greater volume of groundwater was previously pilot tested at the site and discontinued due to the amount of operator attention required. Constructing and operating a full scale treatment system would be extremely expensive, and DNAPL migration would not be addressed by the hydraulic control.

6.2 DECISION OF THE SITE MANAGERS

The site managers (ODEQ and EPA Region 10) are seriously considering a combination of the above strategies.

According to the site managers, a barrier wall will be installed and will likely have a configuration similar to that shown in Figure 1-2. It will be keyed into the low permeability layer in most areas where one exists but will be "hanging" in areas like the FWDA where the low permeability layer does not exist. The site managers expect the wall to contain the unquantified amount of NAPL remaining onsite. Efforts, however, may be required to prevent migration of NAPL through the "hanging" portions of the wall. Due to the lower installation costs, site managers will likely have the wall constructed of a bentonite slurry rather than sheet piling.

Because the planned barrier wall will be approximately 50 feet from the edge of the river and 500 feet from the outer limit of the NAPL contaminated sediments, a significant amount of mobile NAPL may exist beyond the influence of the wall and may continue to impact the river through seeps. To contain some of this NAPL, interceptor trenches may be installed along the beach in both the Willamette

Cove area and along the river front. These trenches, if installed, would be approximately 10 feet deep and 40 feet long, filled with an adsorptive/sequestering material, and then capped. It is assumed that no further O&M would be required with the exception of occasionally collecting bore samples to determine the remaining capacity of the material. Eventual replacement of this material may be required when it has reached its adsorptive capacity.

Finally, a sediment cap will be installed to prevent exposure to contaminated sediments. Site managers are considering a cap primarily constructed of readily available, permeable material with semi-impermeable material in the NAPL seep areas in the Willamette Cove, adsorptive material in the NAPL seep areas along the riverfront, and armoring to prevent scouring. The performance of these materials would be evaluated during O&M and future modifications and replacement of compromised cap material would be made based on lessons learned from these evaluations.

Thus, based on the costs estimates provided by the site managers and contractors, the groundwater and remedial strategies selected by the site managers will likely exceed \$7 million to implement. Additional costs, similar to those currently incurred (approximately \$100,000 per year), likely will be necessary for gaging monitoring points, project management, and reporting.

6.3 ADDITIONAL RECOMMENDATIONS FROM THE RSE TEAM

The following recommendations are made subsequent to the RSE visit and conference calls with the site managers and are also aimed at improving effectiveness, reducing life-cycle costs, and gaining site closeout.

6.3.1 IMPLEMENT STRATEGIES IN PHASES WITH DEFINED SCHEDULES AND BUDGETS

Consistent with the site management's decision, the RSE team recommends a phased approach to implementing these strategies as construction or implementation of one element may change the design parameters of the other units or yield valuable site information pertinent to the implementation of the other elements. For example, construction of the barrier wall may indicate the vertical extent and location of NAPL seeps. Such information would be useful in the final design and implementation of possible cutoff trenches or the sediment cap. Such information would also be useful in designing a monitoring program for evaluating the effectiveness of the implemented strategies. Given the timeframe of implementation presented by the site managers, the barrier wall will hopefully be installed in Spring of 2002, and installation of the cap may wait until the winter or the following summer. Thus, ample time will be available to incorporate information gained through wall construction or through monitoring of site conditions after the wall is constructed.

A work plan including key activities and decision points schedules, design budgets, and construction cost estimates should be developed if it has not been already.

6.3.2 TAKE AN EXPERIMENTAL APPROACH AND APPLY LESSONS LEARNED

The RSE team agrees with the site managers that lessons learned at various stages of the project should be incorporated in future modifications. Applying knowledge learned from the construction of the barrier wall to the construction of the sediment cap or potential intercept trenches (as discussed in Section 6.3.1) serves as an example of this approach. However, an initial approach should be agreed upon and implementation begun since at this point characterization and research are as complete as feasible.

Monitoring and evaluation of site conditions after the wall and cap are in place will improve characterization and also provide lessons for future modifications, if needed. For example, the seep locations have not been fully characterized because areas contaminated by spills and by seeps cannot easily be distinguished. If a properly constructed sediment cap is chosen, implemented, and monitored, then exposure to river sediments contaminated by spills should be significantly reduced or eliminated. If the seeps continue after the installation of the barrier wall, then the locations where the surface of the cap material is contaminated should indicate seep areas. A monitoring program should therefore indicate the location of the seeps and the approximate time to breakthrough, providing additional information for determining the best approach for addressing the seep areas in the future. If seep areas are found to be limited to shallow areas, shallow intercept trenches may be effective at capturing the migrating NAPL. However, if seep areas are prevalent throughout the cap area, another approach may be beneficial, such as an impermeable cap with drains installed to prevent migration around the cap.

Caution should be given to drawing conclusions from uncontrolled experiments such as using various cap materials in different locations. For example, the adsorptive material proposed for the cap along the riverfront may appear to outperform the dredged material from the Willamette River for the Willamette Cove area. However, this difference in performance could be due to the characteristics specific of the respective seeps rather than the materials.

6.3.3 EXPAND PERMEABILITY MODELING AND CONDUCT A COST BENEFIT ANALYSIS OF VARIOUS SEDIMENT CAPS

Permeability modeling has been conducted for a cap constructed from dredged material from the Columbia River and three model scenarios: a fixed NAPL seepage rate, NAPL driven by groundwater flux, and NAPL driven by buoyancy. Due to a lack of reliable data available on the properties of the NAPL, NAPL saturation, and the seepage rate at the McCormick and Baxter site, a number of assumptions were used in deriving the modeling parameters. The groundwater flux scenario, did however, use information obtained from a site-specific groundwater flow model. These assumptions have resulted in a relatively broad range of expected time for NAPL to breakthrough the cap (ranging from 2 months for NAPL driven by buoyancy to 2 years for NAPL driven by groundwater flux). Although broad, this range of breakthrough times does assist in determining the appropriate cap.

A couple of additional inexpensive (i.e., less than \$10,000 total) simplistic studies with the same model should be conducted to determine the sensitivity of NAPL breakthrough time with respect to cap material, with special attention to the finer cap material proposed for use in the Willamette Cove area and the adsorptive material proposed for the riverfront. The results of such studies would assist in a cost-benefit analysis of various caps.

A cost-benefit analysis should be conducted to help determine the best cap material. The primary factors in this analysis should include the following parameters:

- initial cost of installation
- estimated time to breakthrough
- estimated replacement costs as a function of area requiring replacement and material to be replaced

Assuming each material is replaced sufficiently often to maintain effectiveness, the cap material (e.g., dredged material from Columbia River or Willamette River dredge or adsorptive material) with the

lowest life-cycle cost will likely be the best choice for the sediment cap. Such an analysis may or may not indicate that the upfront costs of an adsorptive material may sufficiently reduce the frequency of replacement in seep areas such that life-cycle costs associated with this material are less than life-cycle costs associated with a material requiring more frequent replacement.

It should be noted that this cost-benefit analysis and the currently employed permeability model can only be used as a tool to provide estimates. Certain assumptions used in the modeling may turn out to be false and factors not considered in model development may affect the results. For example, if the fine materials used from the Willamette River dredged material are placed over seep areas and have a hydraulic conductivity significantly lower than that of the surrounding cap material (e.g. sand from Columbia River dredged material) then a substantial portion of the NAPL may migrate around this more impermeable material as it would with a fully impermeable cap. In addition, the seep areas have not been and likely will not be completely defined before installation of the cap, and even if they are, conditions may change after installation of the wall or with variations annual rainfall.

6.4 UNUSED EQUIPMENT

With the termination of the NAPL collection systems and the total fluids extraction and treatment, the site may have government-owned equipment that is no longer required for site activities. If continued use of government-owned equipment is no longer required, the site managers should consider making it available to other Fund-lead sites. USACE has a program designed to help the transfer of unused government equipment from Fund-lead sites to other Fund-lead sites where the equipment can be used. The contact for this program is

Lindsey K. Lien, PE
U.S. Army Corps of Engineers
12565 West Center Road
Omaha, NE 68144-3869
(402) 697-2580
Lindsey.K.Lien@nwd02.usace.army.mil

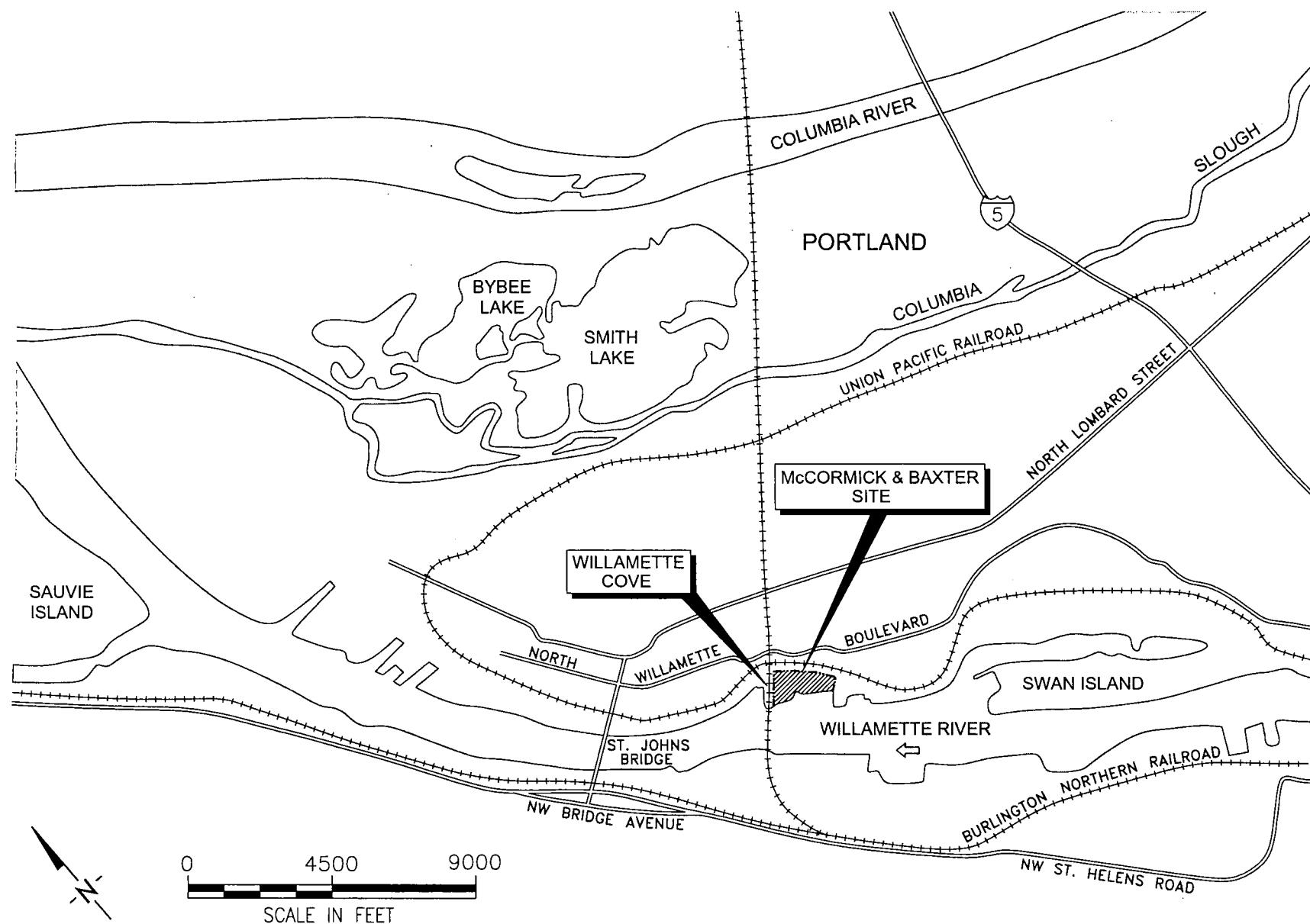
7.0 SUMMARY

The RSE process for the McCormick and Baxter site succeeded in providing recommendations to improve effectiveness and reduce life-cycle costs. These recommendations applied to the site as a whole rather than to the extraction and treatment systems which had been discontinued. Given that site managers were engaged in determining the alternate remedial strategies to be employed to at the site, the RSE team provided recommendations with respect to these strategies. Many of the recommendations occurred during discussions with site managers during the site visit and in subsequent conference calls and took the form of both constructive criticism of proposed strategies and contribution of additional strategies.

The RSE team also encourages implementing strategies in a phased approach with defined schedules and budgets, conducting detailed cost-benefit analyses various options, and applying knowledge learned from monitoring and evaluation to future modifications to the remedy. Because decisions regarding the future remedial strategies at the site were arrived through group discussions between site managers, site engineers, and the RSE team, the RSE team cannot be credited with the final decision or specific aspects of the proposed solution. Rather, the RSE team can be credited with assisting the site managers by providing an independent review of proposed strategies and offering expertise and knowledge gained from other sites.

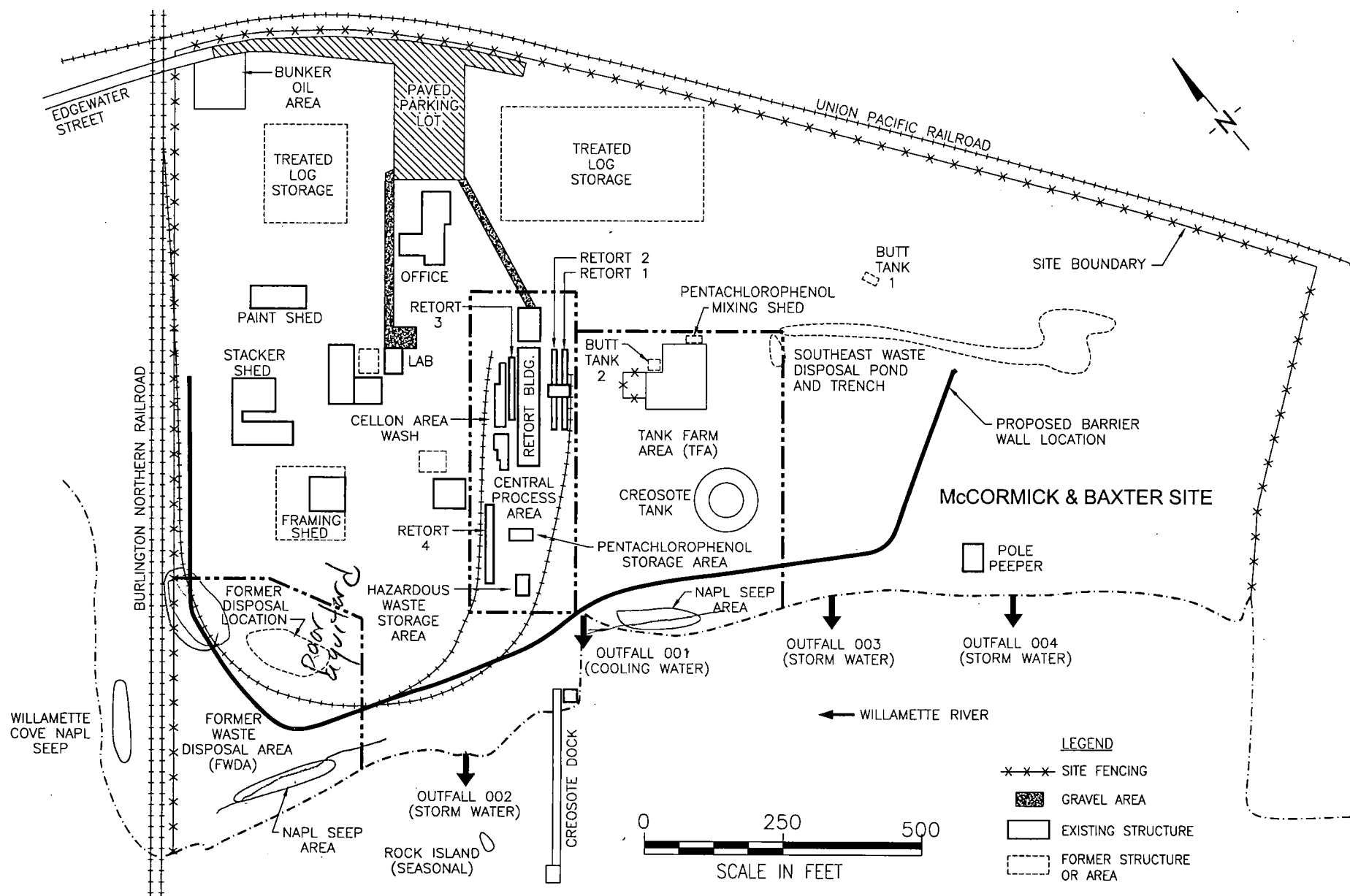
FIGURES

FIGURE 1-1. A MAP OF THE McCORMICK AND BAXTER PROPERTY AND THE SURROUNDING AREA.



(Figure Modified from Figure 1-1 of the McCormick and Baxter Creosoting Company Remedial Investigation Report, PTI Environmental Services, September 1992).

FIGURE 1-2. LAYOUT OF THE McCORMICK AND BAXTER PROPERTY INDICATING FORMER FACILITY STRUCTURES, PRIMARY CONTAMINANT SOURCE AREAS, PERTINENT SITE FEATURES, AND APPROXIMATE LOCATION OF THE PROPOSED VERTICAL BARRIER WALL.



(Figure compiled from Figure 1-2 of the McCormick and Baxter Creosoting Company Remedial Investigation Report, PTI Environmental Services, September 1992 and Figure 1-3 of the Record of Decision, McCormick and Baxter Creosoting Company Superfund Site, Portland, Oregon, March 1996).